Experiment: Common Source Amplifier

Aim:

To implement a common source amplifier of gain 10 and analyze its transient and ac characteristics.

Tool Used:

LTspice

Theory:

The common-source (CS) amplifier for MOSFET is the analogue of the common emitter amplifier for BJT. Its popularity arises from its high gain, and that by cascading a number of them, larger amplification of the signal can be achieved.

For a Level 3 NMOS let's assume

V_{GS} = 0.6V

V_T = 0.4V

V_{DD} = 1.8V

K_n = 120µA/V^2 ,

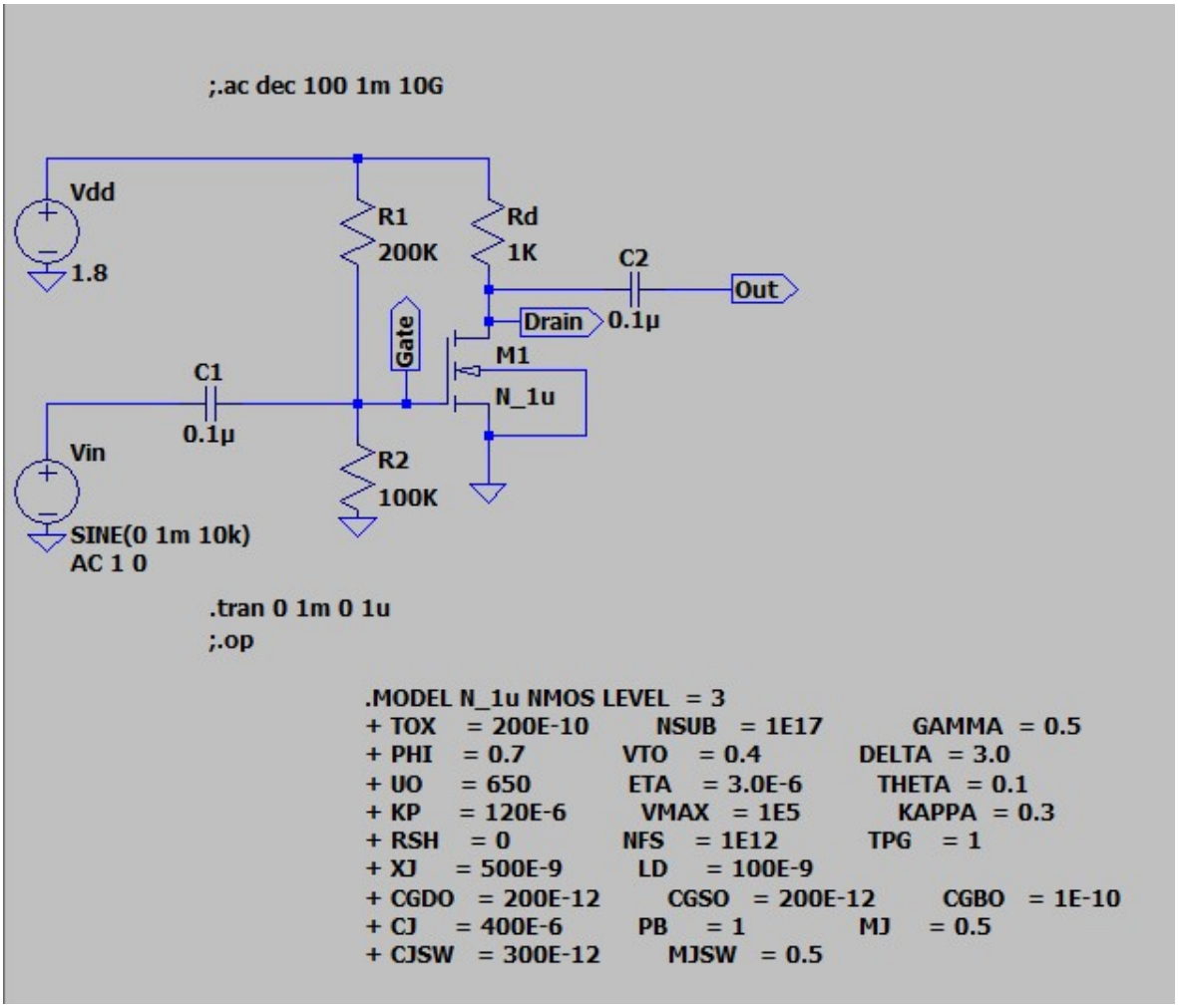
Which gives a value of (W/L) = 416 for 1mA I_D.

Also, for these values g_m is attained as 10mΩ^{-1}, therefore for gain 10, R_D is taken as 1KΩ.

The value of V_{DS} should be maintained above (V_{GS} - V_T = 0.6 - 0.4 = 0.2V) for the transistor to stay in saturation region.

As W/L is 416, the width is taken as 416µm and the length is taken as 1µm.

Circuit Schematic:



Output Waveforms:

DC operating Point

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--- Operating Point ---

V(n001):              1.8              voltage
V(drain):             0.299922         voltage
V(gate):              0.6              voltage
V(n002):              0                voltage
V(out):               2.99922e-008     voltage
Id(M1):               0.00150011       device_current
Ig(M1):               0                device_current
Ib(M1):               -3.09921e-013    device_current
Is(M1):               -0.00150011      device_current
I(C1):                6e-020           device_current
I(C2):                -2.99922e-020    device_current
I(R2):                6e-006           device_current
I(R1):                6e-006           device_current
I(Rd):                0.00150008       device_current
I(Vdd):               -0.00150608      device_current
I(Vin):               6e-020           device_current
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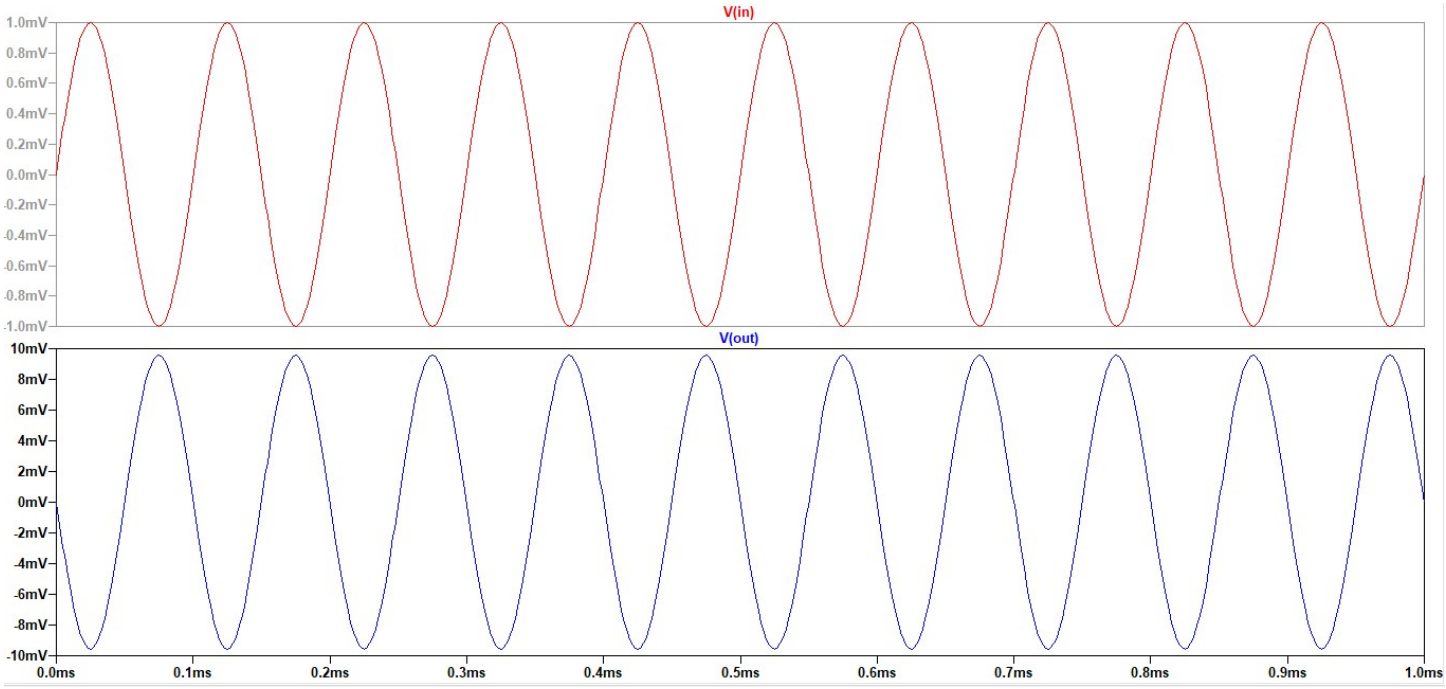
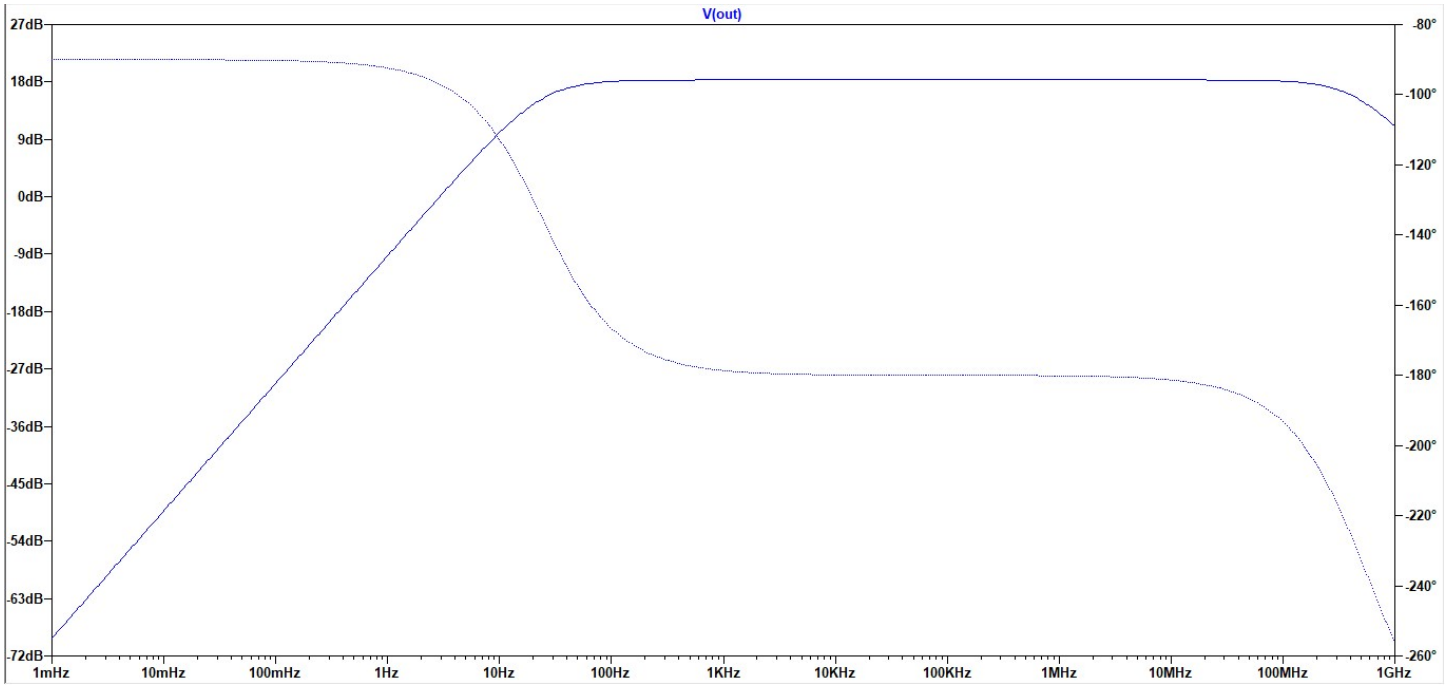
Transient characteristics



AC Analysis



Result:

The circuit is designed for a gain of 10 and the output is verified to be correct. The transient and AC characteristics are visualized.